

6. On the Vagus and Sympathetic Nerves of the Edentata.

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(Text-figures 1-5.)

In a former paper (2) I showed that the cervical parts of the vagus and sympathetic nerves are fused to form vago-sympathetic cords (type 1), or are simply linked together by communicating branches (type 2). And these forms are distributed in the Edentata as follows:—

Type 1:—*Bradypus tridactylus*.

Type 2:—*Euphractus villosus* and *Tatusia novemcincta*.

In *Tamandua tetradactyla* both forms are present in the neck of the same animal, the first occurring on the right side and the second on the left.

In all species the course of the vagi from the foramen lacerum posticum to the point where they reach the sides of the œsophagus in the posterior part of the thorax is similar to that in the Marsupialia (1,2). The relations differ, however, for the branches of the aortic arch are more frequently similar to those in *Homo*. Consequently the relations resemble those described in Anthrotopomy. The branches also differ in many respects from those in the Marsupialia.

Tamandua tetradactyla (text-figs. 1 and 2).

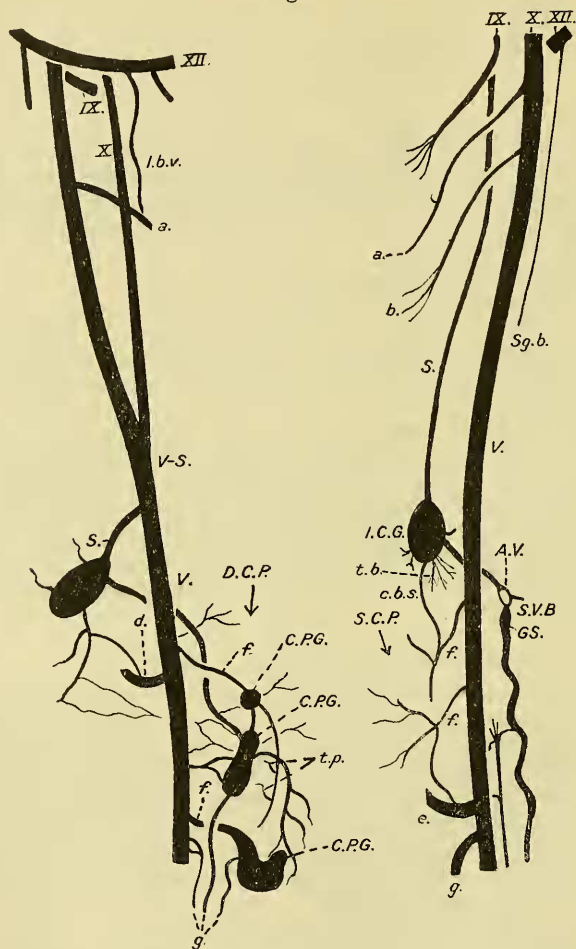
The *vagus nerves* communicate with the glosso-pharyngeal, spinal accessory and hypoglossal nerves by very fine filaments, but no branches run to the sympathetic in the anterior part of the neck. And neither vagus has any trace of the ganglion nodosum in the neck, but they are flatter and wider in the foramen lacerum posticum. The usual branches of distribution are given off, but these have a longer course, and are more easily studied than in most Mammals. They form thick bands, with the spinal accessory nerves in the lacerate foramina.

The *pharyngeal nerve* (a) is the largest cervical branch. It runs along the side of the pharynx and œsophagus and supplies both. It forms a plexus with branches of the glosso-pharyngeal nerve (ix), but no branches of the sympathetic are seen running into it. On the right side a branch (*l.b.v*) of the hypoglossal nerve (xii) communicates with the pharyngeal branch; and this nerve may correspond to what is termed the "lingual branch of the vagus" in human anatomy (3).

The *superior laryngeal nerve* (b) divides into three branches. One gains the interior of the larynx through the thyro-hyoid

interval, and the others end in the extrinsic laryngeal muscles. It does not communicate with the sympathetic.

Text-figure 1.



The cervical and anterior thoracic parts of the vagus and sympathetic nerves in *Tamandua tetradactyla*. *Sg.b.*: branch of hypoglossal nerve to sternoglossus; V-S: vago-sympathetic cord. Other letters in text. The nerves have been separated for demonstration purposes so that the superficial and deep cardiac plexuses appear in line.

The *right recurrent nerve* (*d*) has the usual origin, course, and relations. It communicates freely with the sympathetic (*S*) and the superficial cardiac plexus, and is brought into communication

with the *left recurrent nerve* (*e*) thereby. The latter also communicates with the lower cardiac branch of the left vagus. But no direct branch runs between the two recurrent nerves.

The *Cardiac Nerves* (*f*):—The left vagus gives two fine nerves to the superficial cardiac plexus (S.C.P), wherein they communicate with the cardiac branch from the inferior cervical ganglion of the left sympathetic. But no ganglia are found in connection with them. The right vagus gives two large and two fine filaments to the deep cardiac plexus (D.C.P), and fine filaments to the superficial one. Reddish-brown ganglia are connected to the nerves. There are no upper or middle cervical cardiac nerves.

The *pulmonary nerves* (*g*) come from the vagus on the left side, and from the vagus and deep cardiac plexus on the right.

In the *posterior part of the thorax* branches are given off to the œsophagus and aorta, and the œsophageal plexus (O.P) is a link between the vagi, for there are no direct branches connecting them. And the main cords run through the diaphragm on the sides of the œsophagus.

Abdominal Parts of the Vagi:—The left vagus runs along the ventral surface of the stomach close to the lesser curvature. The right one crosses behind the œsophagus and breaks up into a number of filaments. These reunite and the vagus ends in the right part of the celiac plexus. Several gastric nerves (*j*) run to the dorsal aspect of the stomach, and communicating twigs run to the hepatic (*i*) and splenic (*k*) plexuses.

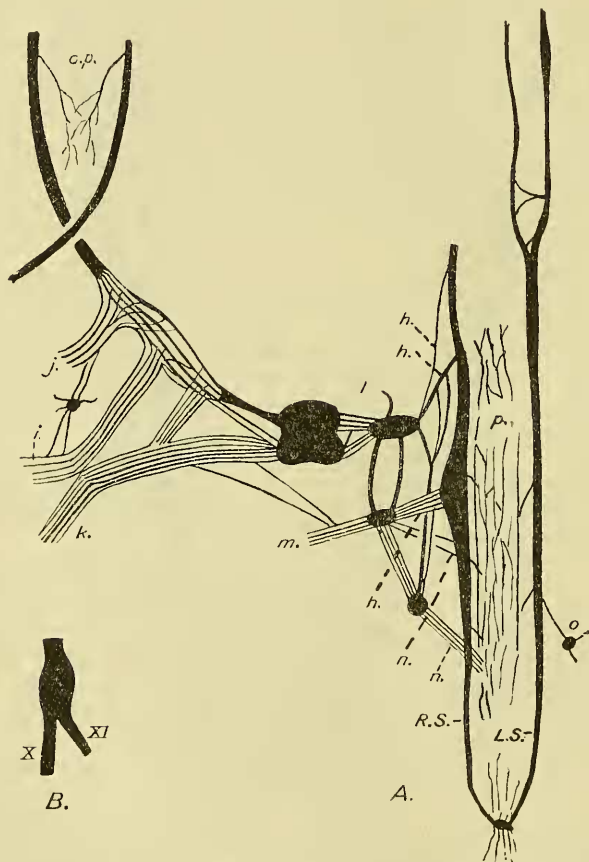
I did not observe any communications between the vagus and phrenic nerves; but fibres may get from the vagus into the phrenic sympathetic plexus and be carried up to the diaphragm to anastomose with the phrenic nerve.

The *Cervical Sympathetic*:—The superior and middle cervical ganglia are absent, but the inferior cervical ganglia (I.C.G) are large and round. They give off the cardiac nerves (*c.b.s*), thymic branches (*t.b*), subclavian (S.V.B) and phrenic communicating (*c.p.n*) nerves. The left cardiac nerve ends in the superficial cardiac plexus. The right cardiac branch ends in the deep plexus. The right sympathetic communicates with the superficial cardiac plexus and left recurrent nerve.

The *Cardiac Plexus* surrounds the aorta and its branches, supplies them and the heart, and gives twigs to the right pulmonary plexuses. It consists of superficial (S.C.P) and deep (D.C.P) parts. The former lies on the ventral surface of the aortic arch. It receives branches from both inferior cervical ganglia, two branches from the left vagus, and twigs from both recurrent nerves. The latter lies between the aortic arch and innominate artery ventrally, and the trachea dorsally, and it contains three reddish-brown ganglia (C.P.G). It receives fibres from the right inferior cervical ganglion, and four branches from the right vagus. Branches are given off to the trachea (*t.p*), heart, and right lung. Both plexuses communicate by fine nerves.

The *thoracic cords* have few ganglia. The first left ganglion (G.S) is long, and connected by the Annulus of Vieussens (A.V) to the inferior cervical ganglion. When ganglia are present they lie on the necks of the ribs. The left cord is tortuous and diminishes in thickness from before backwards; it united

Text-figure 2.



The posterior thoracic and abdominal parts of the vagus and sympathetic nerves in *Tamandua tetradactyla* (A), and the fused vagus and spinal accessory nerves in the lacerate foramina (B). The vagi have been drawn to the right so as to extend the celiac plexus. Letters in text.

posteriorly by two filaments with a branch running up to the aorta at the upper end of the descending part. The right sympathetic is larger than the left one, and is not connected to

any ascending aortic branch. In addition to the communicating nerves to the intercostals, and filaments to the œsophagus, aorta and mediastinum, splanchnic nerves are given off.

The *Solar or Celiac Plexus* (text-fig. 2) consists of several ganglia and communicating bundles of fibres, and is divisible into upper and lower parts. It is connected to the sympathetic cords by splanchnic nerves (*h*); these are three in number, but the lowest is really a bundle of fibres. It lies between the layers of the mesentery, along the course of the celiac axis, and is not set across the vertebral column. The following are the branches of distribution:—

A. From the upper part of the plexus.

1. *Hepatic plexus* (*i*) which communicates with the gastric branches of the right vagus (*j*) by nerves meeting in a small ganglion.

2. *Splenic plexus* (*k*) communicating with the right vagus and supplying spleen and pancreas.

3. *Phrenic plexus* (*l*) communicating with the phrenic nerve in the diaphragm.

B. From the lower part of the plexus.

1. *Right renal plexus* (*m*).

2. Communicating branches to the splanchnic nerves and aortic plexus (*n*).

The *Aortic Plexus* (*p*) accompanies the aorta and its branches. It communicates with the splanchnic nerves, sympathetic cords (RS and LS), and their common ganglion. And it gives off the *left renal plexus* (*o*).

The abdominal parts of the sympathetic have few ganglia. They gradually diminish in size and meet in a common ganglion in front of the sacrum. From the latter nerve plexuses run to the pelvic viscera.

Euphractus villosus (text-figs. 3 and 4).

The vagus and sympathetic nerves differ in many ways from those in *Tamandua*.

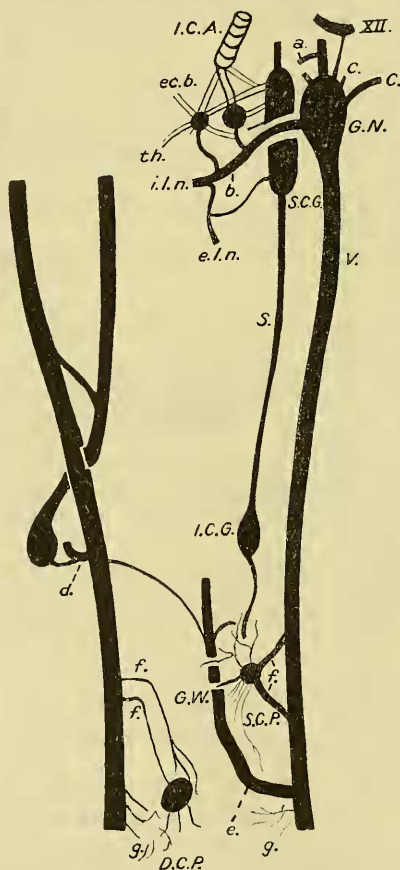
The *Vagus Nerves*:—The ganglion nodosum (G.N) is present on both sides. And the branches of communication to the other cranial nerves and the superior cervical ganglion of the sympathetic are well marked. In the middle of the neck a thick communicating branch connects the right vagus and sympathetic.

The *pharyngeal branch* (*a*) arises above the ganglion nodosum, and no nerve connects it to the hypoglossal nerve.

The *superior laryngeal nerve* (*b*) is a thick branch arising from the centre of the ganglion nodosum. It divides into a thick internal laryngeal nerve (*i.l.n*) and a thin external laryngeal nerve (*e.l.n*) which receives a loop from the superior cervical

ganglion of the sympathetic. Two small ascending branches pass to ganglia whence fibres run up to, and along the course of the arteries. At the level of these ganglia the common carotid artery divides into thyroid, ectocarotid, entocarotid, and occipital arteries, and fibres from the ganglia accompany them. The ganglia also communicate with the superior cervical ganglion of the sympathetic.

Text-figure 3.



The cervical and anterior thoracic parts of the vagus and sympathetic nerves in *Euphractus villosus*. The superior cervical ganglion (S.C.G.) has been cut down as it is very large and round and masks other structures. Letters in text.

The *Cardiac Nerves* (*f*):—The two cardiac branches of the left vagus end in a well-marked ganglion lying in front of the lower

border of the aortic arch. Fibres radiate from it over the arch and its branches, and constitute the superficial cardiac plexus. A branch of the *left recurrent nerve* (*e*) ends in the plexus, but the recurrent and lower left cardiac nerves do not communicate as in *Tamandua*. The right vagus gives two branches to the deep cardiac plexus, but none to the superficial one.

The *right recurrent nerve* (*d*) has the usual origin, course, and relations. It communicates with the sympathetic, and a fine branch crossing the front of the trachea, connects it to the left nerve.

The *pulmonary nerves* (*g*) are given off as the vagi reach and pass behind the roots of the lungs. And they are connected by fine nerves to the deep cardiac plexus.

The *posterior thoracic parts of the vagi* differ from those in *Tamandua*. The right vagus runs along the ventral aspect in the œsophagus. The left nerve runs along the dorsal surface of the œsophagus and communicates with the right one. It gives ascending, transverse, and descending branches to the œsophagus and aortic plexus. *In the abdomen* the right vagus breaks up into a number of branches which run along the ventral surface of the stomach close to the lesser curvature. The left vagus gives several twigs to the celiac plexus and its offshoots, and ends in the dorsal wall of the stomach.

The *Cervical Sympathetic*:—The superior cervical ganglion (S.C.G) is large and round. It communicates with the cranial nerves in its vicinity, and sends a loop to the external laryngeal nerve (*e.l.n.*). Twigs of communication run to the ganglia connected to the laryngeal nerve. The internal carotid nerve (*i.c.n.*) is given off as usual to accompany the internal carotid artery into the skull. The *middle cervical ganglia* are absent, and the *inferior cervical ganglia* (I.C.G) are smaller and narrower than those in *Tamandua*. And the cardiac nerves are similar to those in the latter.

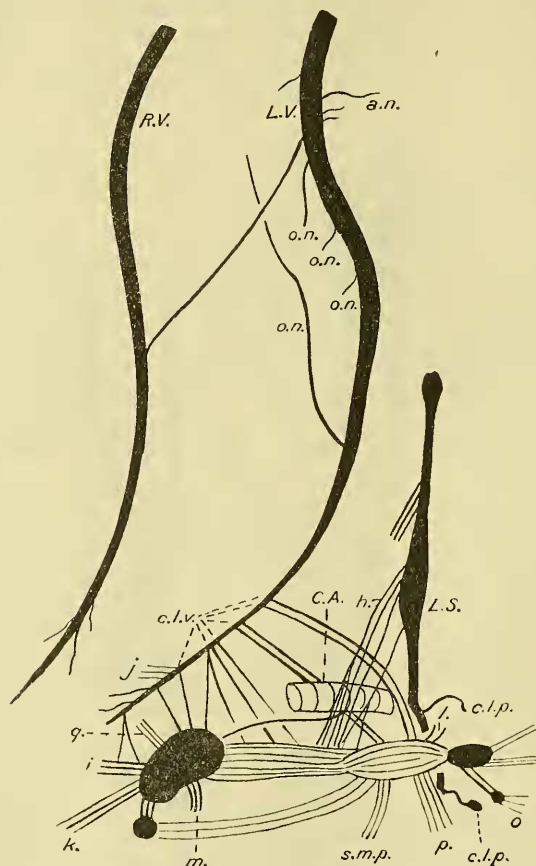
The *Cardiac Plexuses* (S.C.P and D.C.P) differ from those in *Tamandua*. The superficial one is formed entirely by the left vagus and sympathetic, and has a well-marked ganglion of Wrisberg (G.W). The deep plexus is composed of branches of the right vagus and sympathetic, and its solitary ganglion is applied to the wall of the right auricular appendix. The two plexuses are united by fine communicating branches.

The *thoracic cords* contain few ganglia as in *Tamandua*. They increase in thickness from before backwards, and the splanchnic nerves (*h*) are given off from an enlargement. There is no branch comparable to the ascending aortic branch in *Tamandua*. The *abdominal part* has few ganglia, and its rami communicantes to the lumbar nerves (*c.l.p.*) are well marked.

The *Celiac Plexus* (text-fig. 4) consists of right and left halves connected by bundles of fibres, and united to the sympathetic cords by the splanchnic nerves (*h*). It lies between the layers of the common mesentery, along the course of the celiac axis.

It differs from that in *Tamandua* in that it receives branches of the left vagus, whereas that of the latter receives the right vagus.

Text-figure 4.



The posterior thoracic and abdominal parts of the vagus and left sympathetic nerves in *Euphractus villosus*. *a.n.*: aortic nerves; *o.n.*: oesophageal nerves. Other letters in text.

There is no division into upper and lower parts. The following are the branches connected to it:—

A. To the right half of the plexus:—

1. Communicating to left vagus (*c.l.v.*).
2. Coronary plexus (*q.*).
3. Hepatic plexus (*i.*).
4. Splenic plexus (*k.*).
5. Right renal plexus (*m.*).

B. To the left half of the plexus :—

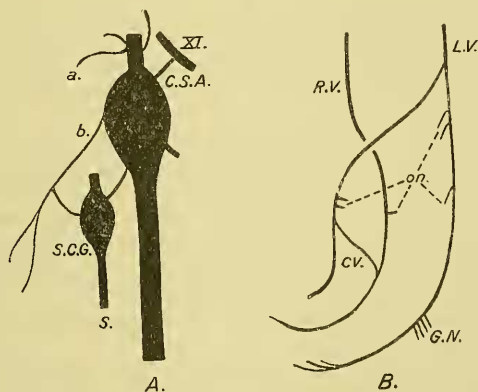
1. Superior mesenteric plexus (*s.m.p.*).
2. Aortic plexus (*p.*).
3. Left renal plexus (*o.*).
4. Phrenic plexus (*l.*).
5. Communicating to left vagus (*c.l.v.*).

The arrangement differs, therefore, from that in *Tamandua*.

Tatusia novemcincta (text-fig. 5).

The *Vagus Nerves*:—Both ganglia nodosa are present, and communicating branches run to the superior cervical ganglion of the sympathetic and other cranial nerves in its vicinity; and the branch to the spinal accessory is very prominent (*c.s.a.*). The *pharyngeal branch* (*a.*) resembles that in *Euphractus*. No branches run to the sympathetic trunk.

Text-figure 5.



The vagus and sympathetic in *Tatusia novemcincta*. A. Upper cervical part; B: posterior thoracic and abdominal parts of the vagi. Description in text.

The *superior laryngeal nerve* (*b.*) forms a loop which communicates with the sympathetic cord distal to the superior cervical ganglion; but no vascular nerves run upwards from it, as in *Euphractus*. No lingual branch of the vagus is present as in *Tamandua*.

The *Cardiac Plexuses* have the usual mode of formation, but the superficial one has no Ganglion of Wrisberg.

In the posterior part of the thorax the left vagus divides into two. One branch runs along the dorsal aspect of the œsophagus, communicates with the cœliac plexus and ends on the dorsal gastric wall. The other branch runs along the ventral aspect of the œsophagus, communicates with the right vagus and ends on

the ventral wall of the stomach. The right vagus runs along the lesser curvature of the stomach to the pyloric region. Both vagi send branches to the œsophagus.

The *Celiac Plexus* resembles that in *Euphractus* in most points.

Summary and Conclusions.

1. The course of the vagus nerves resembles that in the Marsupialia, but their thoracic relations are similar to those in Man.

2. The superior cervical sympathetic ganglia are present in the neck in *Euphractus* and *Tatusia*, but are represented by wide expansions within the foramen lacerum posticum in *Tamandua*.

3. In *Tamandua* the pharyngeal plexus is more complicated than that in *Euphractus* or *Tatusia*, and it is the only species in which the lingual branch of the vagus is present.

4. In *Euphractus* the nerves accompanying the branches of the common carotid artery are larger and more numerous than in the other genera.

5. No Edentate examined by me has a middle cervical sympathetic ganglion, and the thoracic ganglia are few in number.

6. The cardiac plexuses are built on the same plan, but there are variations in detail in their communications and ganglia in the various species.

7. Each species exhibits a different arrangement of the vagi in the posterior part of the thorax, and their intercommunications are variable.

8. The solar plexus in *Tamandua* differs in its arrangements and distribution from that in *Euphractus* and *Tatusia*. It does not lie across the vertebral column, but is situated within the mesentery along the course of the celiac axis.

9. The splanchnic nerves are well-developed in all species, but do not all arise from ganglia.

10. There is no separate depressor nerve, and no external communication between the superior and recurrent laryngeal nerves as in *Hyrax capensis* and Man.

Bibliography.

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